Debt underwriting and bonds

- A bond is an instrument issued for a period of more than one year with the purpose of raising capital by borrowing
- Debt underwriting includes the underwriting of:
 - Government securities
 - Corporate bonds
- Investment banks underwriting role: They organize the sale of the bond to investors.

Role of investment banks



Charateristics of bonds

- 1. Maturity date: The date the issuer repays the face amount to the bondholder
- 2. Face amount: the amount that is repaid at maturity
- 3. Coupon: The interest payment to the bondholders
- 4. Covenants: Special clauses that prohibit the borrower from taking some actions that could jeopardize repayment. Types of clauses:
 - Affirmative covenants (obligation to borrowers)
 - Restrictive clauses (limit borrower actions)
 - Negative covenants (prohibit actions)
 - Default provisions (conditions for repayment)

Types of bonds

- Straight bond: pays a regular fixed coupon, with rthe return of the face amount on maturity date
- Zero-coupon bond: straight bond with no coupon
- Floating rate notes: the coupon is linked to an index, such as interest rates or inflation. This protects the holder against unexpected changes in the index.

- Callable bond: A call provision allows the issuer to repurchase the bond at a fixed price
- Convertible bond: The bondholder has the right to exchange the bond for a given number of shares anytime
- Subortinated bond: Has a lower priority than other bonds. If the issuer bankrupts, repayment is made in priority to the holder of non-subortinated (ie senior) bonds.

Pricing of bonds

Zero coupon bonds

- Has a single payout \$M in n years time
- Call P the market price
- With M and P, we can calculate the current spot rate r for maturity date n:

$$P = \frac{M}{\left(1+r\right)^n}$$

• For a given M, the higher is r the lower the price P

Coupon paying bonds

- Provide a stream of coupons C
- The yield to maturity (YTM) y is such that:

$$P = \frac{C_1}{(1+y)} + \frac{C_2}{(1+y)^2} + \dots + \frac{C_n + M}{(1+y)^n}$$

• Yield to maturity: If a bond sells for price P, has coupon amount C and face value M, with n years to maturity, the yield to maturity on the bond is the annual rate of interest you will receive if you buy the bond now for price P and hold it to maturity.

• Note that when C is constant, P simplifies to:

$$P = \frac{C}{y} \left[1 - \frac{1}{(1+y)^n} \right] + \frac{M}{(1+y)^n}$$

• The YTM can be approximated by:

$$y = \frac{C + (100 - P)/n}{(100 + 2P)/3}$$

Extension to continuous compounding

- Often bonds pay coupons every 6 months
- For a n-year bond, there are 2n coupon payments
- The YTM is then such that:

$$P = \frac{C_1}{(1+y/2)} + \frac{C_2}{(1+y/2)^2} + \dots + \frac{C_{2n} + M}{(1+y/2)^{2n}}$$

YTM and coupon rate

- Call C/M the coupon rate
- If C/M=YTM, then P=M
 → Bond sells at par
- If C/M<YTM, then P<M
- \longrightarrow Bond sells at discount
- If C/M>YTM, then P>M
 → Bond sells at premium

British government securities

- Long-term bonds are called gilts
- Selected IB act as primary dealers
- Conventional stocks account for most of the market: Coupons are paid every 6 months, and there is a fixed payment at maturity
- Index linked stocks: Contrary to conventional stocks, the payments are adjusted to inflation, which provides a hedge against inflation

Pricing

• Imagine you have a £2bn and the following bids:

At £99: for £1000m At £98 30/32: for £500m At £98 28/32: for £1000

Auction

£1000m sold at £99 £500m sold at £98 30/32 £500m sold at £98 28/32 Tender

£2000m sold at £98 30/32

with those who tendered above that price get the full amount tendered, and those who tendered at the price get 50%

- Bid-to-cover ratio = 14 of bids received to the amount awarded.
- Tail of the auction = difference between the average yield of all accepted bids and the high yield.
- This signals the strength of the auction.

US treasury bonds

- Treasury securities are issued with maturity 2, 3, 5, 7, 10 and 30 years
- Treasury bills. Short-term securities with a maturity period of up to one year.
 They do not pay coupons. Holders receive the face amount at maturity.
- Treasury notes: Medium-term securities that have a maturity between 2 and 10 years.
- Treasury bonds: Long-term securities with maturity period of 30 years. They pay coupon every six months.

Price quotes in the UK

- The price is quoted per £100 of nominal stock in decimals.
- Example: a quote of 104.45 means a price of £104.45 for £100 nominal.

Price quotes in the US

- Price quotes are in units of 1/32 of 1% of par (where par is \$100)
- Example of a quote: "6% Feb 26 at 99:07/99:09" refers to a 6% coupon bond redeemable in February 2026 with a bid-ask price of 99-7/32 and 99-9/32

Clean and dirty price

- The quoted price is called the clean price
- In reality, investors pay the "dirty price", which is more than the clean price due to the accrued interests
- When the buyer buys the bond between two coupon payments, he must compensate the seller for the interest for the coupon interest earned since the last coupon
- Accrued interest = C(n1/n2),

where n1 is the number of days from the last coupon payment, and n2 is the number of days in the year

Cum-dividend bond sale

The buyer receives the next coupon.

Hence, the dirty price is the sum of the clean price and the accrued interest.

Ex-dividend bond sale

The next dividend payment goes to the seller. Hence, the dirty price is the clean price minus the rebate interest.

Corporate bonds

- Usually more risky than government bonds
- Governement can avoid default by (i) raising taxes (ii) printing money
- The yield is determined by the credit rating of the issuer
- The credit ratings are decided by credit rating agencies such as S&P, Moody's, and Fitch.

Credit Ratings			
Credit Ri <i>s</i> k	Moody's	S &P	Fitch/IBCA
Investment-grade Highest quality High quality Upper medium grade Medium grade	Aaa Aa A Baa	AAA AA A BBB	AAA AA A BBB
High-yield Somewhat speculative Speculative Poor quality Most speculative No interest payments In default	Ba B Caa Ca C C	BB B CCC CC C D	BB B CCC CC C D

Differences with governement bonds:

1. Collateral

Asset on which the bond owner has first claim in case of default.

- Inside collateral: assets owned by the issuer
- Outside collateral: assets the bond owner would never claim unless they are designated collateral
- Cost of collateral: repossesion costs, monitoring costs
- Debentures refer to unsecured bonds

<u>2. Covenants</u>

- Restrictions imposed on the company to protect the bondholders. (dividend policy, salaries, bonuses, sales of assets, bond issuance...)
- Actions that the company must undertake to protect the bondholders. (liquidate a division, hedge financial risk...)

Underwriting spread

- The spread is typically less than 1% for high-quality issues.
- The spread for junk bonds is around 2-3%.
- The lead underwriter gets 20% of the fee while the syndicate members get the remaining 80%.
- Evidence that the credit quality of the issuer, and the risk faced by underwriter increase the spread.

Proxies for issuer quality: issuer's leverage, credit rating.

Call provision

- A call provision allows the company to repurchase the bond at a known fixed value at specific times in the future
- The call price is above the bond's value. The difference between the call price and the face value is the call premium
- Price of callable bond = price of non callable bond call option value

Example:

Suppose Company A issues a bond paying \$100 in year 1 and \$1100 in year 2. The default risk is zero and the spot rate is 10% for all maturities. At year 1, the spot rates are equally likely to drop to 5% or jump up to 15%.

What is the price of the bond if it is non callable?

What is the price of the bond if it is callable, and the call price of \$1020?

What should the coupon of the callable bond be to equal the price of the callable to the price of the non callable bond?

Why do companies issue callable bonds?

- Superior information of future interest rates. Managers may be better informed than the market on future credit ratings
- Taxes: Call provisions may have tax advantages if the bondholder is taxed at a lower rate than the company
- Future investment opportunities: Calling the bond allows the company to get rid of the covenants that prevent the company to make large investments

Convertible bonds

A call provision allows the company to repurchase the <u>Definition</u>: A convertible bond gives the holder the right to exchange it for a given number of shares anytime up to and including the maturity date of the bond.

The bond is exchanged if the stock price rises sufficiently.

Conversion ratio = number of shares received for each bond

Value of convertible bond =

Max{straight bond value, conversion value} + option value

<u>Example</u>

In November 2003, Oceandoor raised \$300 million by issuing 6.75% convertible debts due in 2022. It planned to use the money raised to invest in a new plant.

Each bond was convertible for 23 shares of common stock (conversion ratio).

Because the face value of the bond was \$1,000, the conversion price was \$43.47.

When Oceandoor issued its convertible bonds, its common stock was trading at \$22.625 per share. The conversion price was 92% higher. This 92% is referred to as the conversion premium.

Example

- 20-year bond with 9% coupon issued at par (\$100) in 2000.
- Current share price: \$2
- Conversion price: \$2.50
- The option can be exercised after 2003
- Conversion ratio = \$100/\$2.5=40
- Conversion premium = (2.5-2)/2=25%

The value of convertible bonds:

1. Straight bond value

$$V = \sum_{i=1}^{n} \frac{C_i}{(1+r)^i} + \frac{M}{(1+r)^n}$$
Straight bond value
Strok price

2. Conversion value: what the bond would be worth if it were immediately converted



3. Option value: Holders need not convert immediately and can wait for the price to rise further. The option to wait has value.



Conflict between convertible bondholders and managers

A convertible bond is a straight debt + a call option.

A call option gives the owner the right to buy an asset at a fixed price during a particular time period.

The value of call options increase with time and risk of firm's cashflows.

Hence, holders of convertible debt maximize value by not converting too early. Managers, instead, want to force conversion as soon as possible.

Managers and holders disagree on the choice of risky projects.

Irrelevance of convertible debts

Convertible debt have lower interest rate than straight debt.

Is it cheap form of financing? No. Holders accept a lower interest rate because of their conversion privilege.

	Firm does badly	Firm does well
Convertible debt	No conversion	Conversion
Straight bonds	CD cheaper financing	CD expensive
Equity	CD expensive	CD cheaper financing

Convertibles and the market's information asymmetry problem

Assumption: Managers know better than investors the value of their company.

The option nature of CD induces managers to issue CD when the prospects of the company are poor. Managers are on the opposite induced to choose straight debt when the prospects of the company are good.

However: investors may anticipate this strategy and offer a lower price for the CD.

Empirical studies: In a two-day period following the announcement of CD, the market price decreases by 2% on average. By contrast, the market does not react to straight debt offerings.

Interpretation of bond yields





The term structure of interest rates

The yield curve

The term structure of interest rates is a way of describing the relationship between interest rates for bonds of different maturities.

 r_1 is the interest rate (in annual terms) on a 1-year bond r_2 is the interest rate (in annual terms) on a 2-year bond r_5 is the interest rate (in annual terms) on a 5-year bond r_{10} is the interest rate (in annual terms) on a 10-year bond

• The <u>term struc</u>s how interest rates vary with yield to maturity.



Key questions

- How to interpret the yield curve?
- What does it tell about the market expectations?
- What does it tell about the default probability of corporate bonds?
- Link to investment banks: underwriting, portfolio management

Forward rates

- Suppose that the yield to maturity on a 1-year bond is 9%, and the YTM is 10% on a 2-year bond.
- What does this tell you about the future spot rates?
- As an investor you can choose between:
 1) Buy a 2-year bond with 10% YTM
 2) Buy a 1-year bond with 9% YTM, and at year 1 reinvest in another 1-year bond.



• The price of the 2-year bond should be such that investors are indifferent between the two alternatives.

• If one alternative was less attractive to investors, its price would drop (yield go up), and the indifference would be restored.

- Forward rate: future spot rate implied by the yield curve
- Call f_{12} the forward rate between year 1 and year 2.
- The "fair" forward rate is such that:

$$(1+r_2)^2 = (1+r_1)(1+f_{12})$$

 $\Rightarrow 1+f_{12} = \frac{(1+r_2)^2}{(1+r_1)} = 1.11009$

• Hence, $f_{12} = 11\%$



With three periods

- Call f_{23} the forward rate between year 2 and year 3.
- The "fair" forward rate is such that:

$$(1+r_3)^3 = (1+r_2)^2 (1+f_{23})$$
$$\Rightarrow 1+f_{23} = \frac{(1+r_3)^3}{(1+r_2)^2}$$

With n periods

- Call $f_{m,m+1}$ the forward rate between year m and year m+1.
- The "fair" forward rate is such that:

$$1 + f_{m,m+1} = \frac{(1 + r_{m+1})^{m+1}}{(1 + r_m)^m}$$

Future contracts

Forward rates allow you to price future contracts.

At t=0 you agree to buy at t=1 a bond for £100 that pays £111 at t=2. This is a future contract on a bond.

The forward price is £100 and is denoted F_0 . It is determined by the future rate f_{12} and the payment at maturity.

$$F_0 = \frac{M}{1 + f_{12}}$$

Interpreting the yield curve: The pure expectations hypothesis

- In order to interpret the yield curve, we have to consider the investors preferences
- The PEH assumes that investors are risk neutral, and base their investment decisions only on expected returns
- Consider an investment of £A in a 3-year bond with yield r_{3t} .
- The terminal value of investment is:

$$TV = \pounds A (1 + r_{3t})^3$$

• Consider the alternative investment of £A in a rolling 1year bond for 3 years:

$$E_t(TV) = \pounds A(1+r_{1t})(1+E_t(r_{1t+1}))(1+E_t(r_{1t+2}))$$

• No arbitrage requires that the investors are indifferent between the two alternatives:

$$(1+r_{3t})^3 = (1+r_{1t})(1+E_t(r_{1t+1}))(1+E_t(r_{1t+2}))$$

Informativity of the yield curve

If rates are expected to remain constant, then the yield curve should be flat. Example:

$$r_{1,t} = r_{1,t+1} = r_{1,t+2} = 4\%$$

 $\Rightarrow r_{2t} = r_{3t} = 4\%$

If spot rates are expected to rise

$$r_{1,t} = 4\%, E_t r_{1,t+1} = 8\%, E_t r_{1,t+2} = 9\%$$
$$\implies r_{2t} = 6\%, r_{3t} = 7\%$$

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• Hence, the yield curve gives information about the market expectations on future rates.

• Since interest rates are positively related to inflation, an upward sloping yield curve could indicate that the market believes inflation will rise.

Term structure of credit risk

Suppose we have the following yields:



- Call⁰¹ the probability of repayment for the corporate BBB bond.
- Risk neutral investors would be indifferent between the two bonds if:

$$p_{01}(1+r_{c1}) = (1+r_1) \Longrightarrow p_{01} = \frac{(1+r_1)}{(1+r_{c1})} = 0.982$$

• Hence the probability of default in year 1 is 1.8%.

• In reality, bondholders recover a fraction of the bond value when a company defaults. Let us denote the fraction of the bond value that is recovered.

$$p_{01}(1+r_{c1}) + (1-p_{01})\theta(1+r_{c1}) = (1+r_{1})$$

• The credit spread, V_1 , is lower the higher is

• Call p_{12} the probability of no default between years 1 and 2.

$$p_{12}(1+f_{c12}) = 1+f_{12}$$
$$\Rightarrow p_{12} = \frac{1+f_{12}}{(1+f_{c12})} = 0.965$$

- Hence, the marginal probability of default in year 2 is 3.5%
 - The cumulative probability of default after 2 years is

$$1 - p_{01}p_{12} = 5\%$$